

Amendment and Response

Applicant: Paul F. Reboa et al.

Serial No.: 10/731,070

Filed: December 9, 2003

Docket No.: 200210084-1

Title: LIGHT MODULATOR

IN THE CLAIMS

Please cancel claims 5, 6, 20, 21, 33, 34, 44, and 45 without prejudice.

Please add new claims 52-61.

Please amend claims 1-4, 8, 12, 13, 16-19, 23, 27-32, 36, 38-43, 47, 50, and 51 as follows:

1. (Currently Amended) A light modulator, comprising:
 - a substrate;
 - a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;
 - at least one electrode-a plurality of electrodes formed on the substrate adjacent the cavity; and
 - a liquid having an index of refraction greater than one disposed within the cavity, wherein an interface of the liquid is oriented at an angle to a surface of the at least one electrode at least one of the electrodes and oriented at an angle to a surface of the transparent plate, wherein light is adapted to pass through and refract at the interface of the liquid, and wherein the transparent plate has an uneven surface including a plurality of recessed areas, wherein the interface of the liquid is provided along the uneven surface within the recessed areas, wherein each of the electrodes is associated with one of the recessed areas of the uneven surface.
2. (Currently Amended) The light modulator of claim 1, wherein the surface of the at least one electrode of the electrodes is substantially planar over an entirety thereof.
3. (Currently Amended) The light modulator of claim 1, wherein the surface of the at least one electrode of the electrodes is oriented substantially parallel with the surface of the transparent plate.
4. (Currently Amended) The light modulator of claim 1, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to the at least one electrode at least one of the electrodes.

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5. (Cancelled)
6. (Cancelled)
7. (Original) The light modulator of claim 1, further comprising:
a transparent electrode formed within the transparent plate.
8. (Currently Amended) The light modulator of claim 1, further comprising:
A light modulator, comprising:
a substrate;
a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;
at least one electrode formed on the substrate adjacent the cavity;
a sidewall extended between the substrate and the transparent plate; and
an additional electrode formed on the sidewall adjacent the cavity; and
a liquid having an index of refraction greater than one disposed within the cavity,
wherein an interface of the liquid is oriented at an angle to a surface of the at least one electrode and oriented at an angle to a surface of the transparent plate.
wherein light is adapted to pass through and refract at the interface of the liquid.
9. (Original) The light modulator of claim 8, wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.
10. (Original) The light modulator of claim 8, further comprising:
a hydrophobic coating formed over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall.

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11. (Original) The light modulator of claim 10, wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.

12. (Currently Amended) The light modulator of claim 1, wherein the surface of the at least one electrode of the electrodes is a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

13. (Currently Amended) The light modulator of claim 1, wherein the substrate is a transparent substrate and the at least one electrode at least one of the electrodes is a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

14. (Original) A display device including the light modulator of claim 1.

15. (Original) An optical switch including the light modulator of claim 1.

16. (Currently Amended) A method of forming a light modulator, the method comprising:

forming a transparent plate with an uneven surface including a plurality of recessed areas;

spacing a the transparent plate from a substrate, including defining a cavity between the transparent plate and the substrate;

forming at least one electrode a plurality of electrodes on the substrate adjacent the cavity, including associating each of the electrodes with one of the recessed areas of the uneven surface; and

disposing a liquid having an index of refraction greater than one within the cavity, including orienting an interface of the liquid at an angle to a surface of the at least one electrode at least one of the electrodes and at an angle to a surface of the transparent plate,

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wherein the interface of the liquid is provided along the uneven surface of the transparent plate within the recessed areas,

wherein light is adapted to pass through and refract at the interface of the liquid.

17. (Currently Amended) The method of claim 16, wherein the surface of the at least one electrode of the electrodes is substantially planar over an entirety thereof.

18. (Currently Amended) The method of claim 16, wherein forming the at least one electrode-plurality of electrodes includes orienting the surface of the at least one electrode of the electrodes substantially parallel with the surface of the transparent plate.

19. (Currently Amended) The method of claim 16, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to the at least one electrode at least one of the electrodes.

20. (Cancelled)

21. (Cancelled)

22. (Original) The method of claim 16, further comprising:
forming a transparent electrode within the transparent plate.

23. (Currently Amended) The method of claim 16, further comprising:A method of forming a light modulator, the method comprising:
spacing a transparent plate from a substrate, including defining a cavity between the transparent plate and the substrate;
forming at least one electrode on the substrate adjacent the cavity;
extending a sidewall between the substrate and the transparent plate; and
forming an additional electrode on the sidewall; and

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disposing a liquid having an index of refraction greater than one within the cavity,
including orienting an interface of the liquid at an angle to a surface of the at least one
electrode and at an angle to a surface of the transparent plate,
wherein light is adapted to pass through and refract at the interface of the liquid.

24. (Original) The method of claim 23, wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.

25. (Original) The method of claim 23, further comprising:
forming a hydrophobic coating over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall.

26. (Original) The method of claim 25, wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.

27. (Currently Amended) The method of claim 16, wherein forming the at least one electrode-plurality of electrodes includes forming the surface of the at least one electrode of the electrodes as a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

28. (Currently Amended) The method of claim 16, wherein the substrate is a transparent substrate, and wherein forming the at least one electrode-plurality of electrodes includes forming the at least one electrode at least one of the electrodes as a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

29. (Currently Amended) A light modulator, comprising:
a substrate;

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a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;

~~at least one electrode~~ a plurality of electrodes formed on the substrate adjacent the cavity;

a liquid having an index of refraction greater than one disposed within the cavity; and means for orienting an interface of the liquid at an angle to a surface of ~~the at least one electrode~~ at least one of the electrodes and at an angle to a surface of the transparent plate, wherein light is adapted to pass through and refract at the interface of the liquid,

wherein means for orienting the interface of the liquid includes an uneven surface of the transparent plate, the uneven surface including a plurality of recessed areas and the interface of the liquid being provided along the uneven surface within the recessed areas, wherein each of the electrodes is associated with one of the recessed areas of the uneven surface.

30. (Currently Amended) The light modulator of claim 29, wherein the surface of the ~~at least one electrode~~ of the electrodes is substantially planar over an entirety thereof.

31. (Currently Amended) The light modulator of claim 29, wherein the surface of the ~~at least one electrode~~ of the electrodes is oriented substantially parallel to the surface of the transparent plate.

32. (Currently Amended) The light modulator of claim 29, wherein the index of refraction of the liquid is adapted to change when an electrical signal is applied to ~~the at least one electrode~~ at least one of the electrodes.

33. (Cancelled)

34. (Cancelled)

35. (Original) The light modulator of claim 29, further comprising:
a transparent electrode formed within the transparent plate.

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36. (Currently Amended) The light modulator of claim 29, further comprising: A light modulator, comprising:

a substrate;

a transparent plate spaced from the substrate, the transparent plate and the substrate defining a cavity therebetween;

a sidewall extended between the substrate and the transparent plate;

at least one electrode formed on the substrate adjacent the cavity;

a liquid having an index of refraction greater than one disposed within the cavity; and
means for orienting an interface of the liquid at an angle to a surface of the at least
one electrode and at an angle to a surface of the transparent plate, wherein light is adapted to
pass through and refract at the interface of the liquid,

wherein means for orienting the interface of the liquid includes an additional electrode formed on the sidewall, wherein the liquid is adapted to move toward the additional electrode and establish the interface of the liquid at the angle to the surface of the at least one electrode when an electrical signal is applied to the additional electrode.

37. (Original) The light modulator of claim 36, wherein means for orienting the interface of the liquid further includes a hydrophobic coating formed over the at least one electrode formed on the substrate and the additional electrode formed on the sidewall, and

wherein the liquid is adapted to change between a hydrophobic liquid and a hydrophilic liquid when an electrical signal is applied to the additional electrode.

38. (Currently Amended) The light modulator of claim 29, wherein the surface of the at least one electrode of the electrodes is a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

39. (Currently Amended) The light modulator of claim 29, wherein the substrate is a transparent substrate and the at least one electrode at least one of the electrodes is a

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transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

40. (Currently Amended) A method of controlling light with a light modulator including at least one electrode-a plurality of electrodes formed on a substrate, the method comprising:

directing light through a transparent plate spaced from the substrate and through a cavity defined between the transparent plate and the substrate, including directing the light toward an uneven surface of the transparent plate including a plurality of recessed areas, wherein each of the electrodes is associated with one of the recessed areas of the uneven surface; and

directing the light through a liquid having an index of refraction greater than one disposed within the cavity, including passing the light through and refracting the light at an interface of the liquid, wherein the interface of the liquid is oriented at an angle to a surface of the at least one electrode-at least one of the electrodes and oriented at an angle to a surface of the transparent plate, wherein the interface of the liquid is provided along the uneven surface of the transparent plate within the recessed areas.

41. (Currently Amended) The method of claim 40, wherein the surface of the at least one electrode-of the electrodes is substantially planar over an entirety thereof.

42. (Currently Amended) The method of claim 40, wherein the surface of the at least one electrode-of the electrodes is oriented substantially parallel to the surface of the transparent plate.

43. (Currently Amended) The method of claim 40, further comprising:
applying an electrical signal to the at least one electrode-at least one of the electrodes and changing the index of refraction of the liquid.

44. (Cancelled)

45. (Cancelled)

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46. (Original) The method of claim 40, wherein directing the light through the transparent plate includes directing the light through a transparent electrode formed within the transparent plate.

47. (Currently Amended) The method of claim 40, further comprising: A method of controlling light with a light modulator including at least one electrode formed on a substrate, the method comprising:

directing light through a transparent plate spaced from the substrate and through a cavity defined between the transparent plate and the substrate;

directing the light through a liquid having an index of refraction greater than one disposed within the cavity, including passing the light through and refracting the light at an interface of the liquid, wherein the interface of the liquid is oriented at an angle to a surface of the at least one electrode and oriented at an angle to a surface of the transparent plate; and

applying an electrical signal to an additional electrode of the light modulator, including moving the liquid toward the additional electrode and establishing the interface of the liquid at the angle to the surface of the at least one electrode.

48. (Original) The method of claim 47, wherein the at least one electrode and the additional electrode each have a hydrophobic coating formed thereover.

49. (Original) The method of claim 48, wherein applying the electrical signal to the additional electrode includes changing the liquid between a hydrophobic liquid and a hydrophilic liquid.

50. (Currently Amended) The method of claim 40, wherein the surface of the at least one electrode of the electrodes is a reflective surface, and further comprising:

reflecting the light with the reflective surface of the at least one electrode of the electrodes, including directing the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

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51. (Currently Amended) The method of claim 40, wherein the at least one electrode at least one of the electrodes is a transparent electrode and the substrate is a transparent substrate, and further comprising:

directing the light through the transparent electrode and the transparent substrate.

52. (New) The light modulator of claim 8, wherein the surface of the at least one electrode is a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

53. (New) The light modulator of claim 8, wherein the substrate is a transparent substrate and the at least one electrode is a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

54. (New) A display device including the light modulator of claim 8.

55. (New) An optical switch including the light modulator of claim 8.

56. (New) The method of claim 23, wherein forming the at least one electrode includes forming the surface of the at least one electrode as a reflective surface, wherein the reflective surface is adapted to reflect the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

57. (New) The method of claim 23, wherein the substrate is a transparent substrate, and wherein forming the at least one electrode includes forming the at least one electrode as a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

58. (New) The light modulator of claim 36, wherein the surface of the at least one electrode is a reflective surface, wherein the reflective surface is adapted to reflect the light

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through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

59. (New) The light modulator of claim 36, wherein the substrate is a transparent substrate and the at least one electrode is a transparent electrode, wherein the light is adapted to pass through the transparent electrode and the transparent substrate.

60. (New) The method of claim 47, wherein the surface of the at least one electrode is a reflective surface, and further comprising:

reflecting the light with the reflective surface of the at least one electrode, including directing the light through the liquid, through the interface of the liquid, and through the surface of the transparent plate.

61. (New) The method of claim 47, wherein the at least one electrode is a transparent electrode and the substrate is a transparent substrate, and further comprising:

directing the light through the transparent electrode and the transparent substrate.